Dispersants in the Wake of the *Deepwater Horizon* Spill, with Dana Wetzel

Ashley Ahearn

Although dispersants have been used to help clean up oil spills since the 1960s, it wasn't until the *Deepwater Horizon* disaster in the Gulf of Mexico that these chemicals made their way into the public consciousness. Use of dispersants always involves an environmental tradeoff, but the *Deepwater Horizon* situation presents special considerations because the chemicals are being used a mile underwater for the first time ever. In this podcast, Dana Wetzel discusses the dispersants used in the *Deepwater Horizon* spill, including what we do and don't know about their potential effects on Gulf ecosystems. Wetzel is a senior scientist and program manager at the Mote Marine Laboratory in Sarasota, Florida.

AHEARN: It's *The Researcher's Perspective*. I'm Ashley Ahearn.

The explosion of the *Deepwater Horizon* oil rig marked the beginning of one of the worst environmental disasters in this country's history. At the time of this recording, an estimated 200 million gallons or more of crude oil[1] may have flowed into the Gulf of Mexico.

The images of environmental degradation are heartbreaking—dolphins struggling for survival, pelicans weakly flapping oil-slicked wings; these animals are on the frontlines of the disaster.

But beneath the surface, as the oil begins to break down in the environment and make its way up the food chain—from the smallest bacteria and phytoplankton—there are more questions than answers about the environmental health impacts of the *Deepwater Horizon* disaster.

Dr. Dana Wetzel, a senior scientist and program manager at the Mote Marine Laboratory in Sarasota, Florida, is working around the clock to answer those questions. She's been studying the environmental impacts of oil contamination for 17 years.

Dr. Wetzel, thanks so much for taking a moment to talk with me. I know how busy you are right now.

WETZEL: You are more than welcome Ashley. I appreciate you inviting me on.

AHEARN: So let's start with crude oil. Why is it toxic?

WETZEL: Crude oil is made up of a lot of different components. Some of them aren't toxic, but some of them are toxic, and most of the toxic fraction of the oil is considered the lighter-molecular-weight components. Those are soluble in water, they volatilize easily, and they are very toxic.

AHEARN: Now tell me about dispersants. BP has applied nearly 2 million gallons[2] of this stuff to essentially break apart the oil into droplets, right? Do you think this is a solution?

WETZEL: I see this as a possible solution. I don't know that anyone can decide right now that the idea of using a dispersant was the right one, but I also don't know that they can argue that it isn't the right one. But dispersant does act as soap—like what you would wash your hands with in the sink if you had oily hands—and the idea is that if you can apply the dispersant to the oil it will break it down into very small particles, which hopefully can do two things. One is it will disperse through the water column so that you won't have such a high concentration of oil, and the other is that it will increase the surface area of the oil allowing the normal bacteria in the water to weather it and degrade it.

AHEARN: And what does that mean for the environment?

WETZEL: Yeah, well, that's a tough call. Unfortunately we don't know a whole lot about this. First of all, no one's ever used dispersants at 5,000 feet deep in a wellhead. What's happening is that you're dispersing oil down at depth, at a mile deep, and that oil now is sort of lingering around, floating around subsurface.

You know, crude oil will always float, at least the nonsoluble fraction of crude oil will float, and that's what you see when you see the masses of oil on the surface of the water. And you've got organisms—marine mammals, sea turtles, birds—that are affected by the oil on the surface. But if you disperse it you've just taken the problem, and you've submerged it, if you will. And now you've got these masses of droplets of oil that you're hoping that bacteria now can degrade a little bit better than the mass of oil would, and you're hoping it would dilute a little bit so you're not getting high levels or high concentrations of oil, but you have made this oil available to fish, to the benthic community, who's now going to filter it through their gills, filter feed, and now you've created a whole 'nother exposure route. So I'm glad I haven't had to make the call on whether to use dispersants or not because it's not an easy decision. There's negatives no matter which way you choose to go.

AHEARN: And what do we know about what dispersants and oil, once they are broken down by these bottom feeders on the food chain—what happens? What are some of the health impacts you see to those organisms?

WETZEL: Well, exposure to oil, you've got what we call "acute effects" and then we call another series of effects "sublethal." And acute effects would be like immediate death. Another acute effect would be if you consider a bird that falls in the oil and gets it all over its feathers. It could drown in the oil. It could die of hypothermia. It could die just from burning of the oil, from the fumes of the oil, and that's what we would consider an acute effect. But then there are what we call "sublethal effects," and sublethal effects are oftentimes much more difficult to measure. Those kinds of effects could include growth impairment, mutagenic or carcinogenic effects. You can disrupt the reproductive

cycle. You can interfere with immune system. There can be psychological stress. And there can be a compilation of multiple stressors in these organisms that have long-lasting effects.

AHEARN: And many of these effects we may not see for generations of these organisms. Is that correct?

WETZEL: You know, that's correct. Let's just pick one of these stressors; let's say it's a reproductive impairment. This organism or this population of organisms may not be effectual reproducers either this year or perhaps next year, or even if they can reproduce, [only] some of them reproduce this year. We don't know what the subsequent generations' effects might end up being.

AHEARN: Now, are there any lessons to be learned from the *Exxon Valdez* and that region?

WETZEL: I think the lesson that is really obvious is that we didn't learn a whole lot after the *Exxon Valdez* spill. We studied it. We measured it. But we don't have a whole lot of new technology that's been created that will help address an oil spill, a massive oil spill, and I think that's where we're lacking.

We can go out and we can measure levels found in organisms, levels of contamination found in organisms, but we still don't know what that means. And let's say someone asks me, "Well, Dr. Wetzel, I see that you have published that you have found 10 parts per million of petroleum in dolphins. What does that mean?" Right now I'd have to say "I don't have a clue," because we don't understand what 10 parts per million means or 10 parts per billion means. Is it nothing, or is it significant? And so what I am focusing my efforts on with my colleagues is that we are looking at identifying sublethal consequences of exposure to oil. We're looking at reproductive impairment to DNA damage. We're looking at immune function deficiencies as a result of exposure. We want to know as

much as we can about what oil could possibly do to a wide variety of organisms and a number of different concentrations.

AHEARN: You're doing some research on coral larvae. Can you talk a little bit about that?

WETZEL: Sure. We are going to be working with coral that are spawning this summer, and we're going to take spawn that has been collected, and we're going to expose the coral larvae to this Corexit[3] dispersant in concentrations that are similar to what you might find dispersed in the environment. And then we're going to take and expose more coral larvae to the water-soluble fraction of the fresh South Louisiana crude oil, and then we're going to take the dispersant and mix it with the fresh crude and expose the organisms to that toxicant, and we're going to try and define a number of things. One is simply an LC_{50}—what is a concentration it's going to take to kill fifty percent of the population of larvae? But then we're also looking at other parameters—how might it affect their settling and colonization? how does it affect their normal bacterial flora around them, which is an important component of the coral?—and looking at a number of different biological end points.

AHEARN: How do you see your work as a researcher in the Gulf of Mexico playing into future policy actions on this disaster?

WETZEL: What I want to be able to bring to the table after this work is complete is to be able to say "OK, if we end up with 5 parts per billion of dispersed oil in water, we're going to see a 25 percent decline in the spawning of coral." I want to be able to put into perspective a reality as a consequence of an oil spill, not just for corals but for, you know, marine mammals, for fish, for oysters, because until we can relate a consequence to an exposure, nobody really knows.

AHEARN: I'm wondering, from your standpoint, is there any good that you see coming out of this, for society or for science?

WETZEL: Yeah, we would be remiss not to try and learn as much as we can from this tragedy, and what we need to understand is what is the consequence of not just an oil spill, but any sort of a chemical spill. We need to study it, understand the impacts on individual organisms, on populations. We need to know how long it's going to be in the environment. And we need to know this in order to make good decisions, informed decisions, on how we're going to treat our environment in the future.

AHEARN: Dr. Wetzel, thank you so much for joining me.

WETZEL: Thank you, Ashley.

AHEARN: Dr. Dana Wetzel is a senior scientist and program manager at the Mote Marine Laboratory in Sarasota, Florida.

And that's *The Researcher's Perspective*. I'm Ashley Ahearn. Thanks for downloading![4]

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[1] Deepwater Horizon Incident Joint Information Center. U.S. Scientific Team Draws on New Data, Multiple Scientific Methodologies to Reach Updated Estimate of Oil Flows from BP's Well [press release]. 15 June 2010. Available: http://www.deepwaterhorizonresponse.com/go/doc/2931/661583/ [accessed 19 July 2010].

[2] Deepwater Horizon Incident Joint Information Center. The Ongoing Administration-Wide Response to the Deepwater BP Oil Spill [press release]. 19 July 2010. Available: http://www.deepwaterhorizonresponse.com/go/doc/2931/794751/ [accessed 19 July 2010].

[3] Corexit 9500 and Corexit 9527 are the dispersants used so far in the *Deepwater Horizon* response. According to the U.S. Environmental Protection Agency, only Corexit 9500 has been used since mid-May.

[4] For more information on the use of dispersants in the *Deepwater Horizon* spill, see "Between the Devil and the Deep Blue Sea: Dispersants in the Gulf of Mexico" [Schmidt CW. Environ Health Perspect 118(8):A338–A344 (2010)].

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